BRUSH SPRING PRESSURE

The suitable brush spring pressure results from both electrical and mechanical considerations. Since the requirements of these considerations are often contradictory, the suitable pressure is, therefore, a compromise.

1 - The basic principle: **Pressure** should be **sufficient to insure a true and continuous contact** of the brush on the slip-ring or commutator and all working conditions of the machine.

In fact all break of the contact of the brush with the ring or commutator is the cause of sparking under the brush. This sparking causes damage to the commutator or slip-ring and a quick wear of the brush.

This basic principle leads to a logical consequence:

i.e. The **brush spring pressure** of machines

– subject to shocks and vibrations (such as traction motors, motors for propellers, overhung motors and shaft and exciters, etc.)

– or machines where the motors have a bad stability (unbalance, out of round)

should be increased to prevent the additional risks of interruption of commutator or slip-ring brush contact.

2 - The **mechanical losses**, the **temperature** and **wear of brushes all increase** with the pressure.

3 - The **contact drop** under the brush **decreases** when the pressure is increased. Consequently the commutating properties of the brush decrease at high pressures.

The decrease of contact drop, when the pressure encreases, should not be considered as insignificant. For an electrographitic brush (at 10 A/cm^2 and 30 m/s) it can reach 30 % when pressure goes from 15 to 55 kPa.

In this way, please, note that the coefficient k_p (lower than 1) which for a pressure p enable the evaluation of the drop from a reference pressure (for instance 15 kPa), that is to say $\Delta U_p = K_p.\Delta U_{15}$, is not a constant coefficient: its value decreases faster for lower pressures than for higher pressures. The table below gives some values of this coefficient resulting from laboratory tests carried out on an electrographitic brush at 10 A/cm^2.

P (kPa)	15	25	35	45	55	65	75
K_p	1	0.90	0.82	0.76	0.71	0.67	0.64

Please, note that 1 kPa = 0.1 kPa and that 1 cN/cm^2 is not very different from 1 g/cm^2.

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This effect is very important mainly for commutators with large chamfers on the bar (space between bars # useful width on the bars) that is in any case where the real pressures are appreciably superior to the visible/apparent pressure or noticeable pressure.

4 - The **maximum tolerable pressure** for a brush **depends on the hardness of the material**. All soft or fragile brushes are eliminated from applications requiring high pressure (i.e. higher than 225 kPa).

In the group of unsuitable grades one would find particularly the soft natural graphite grades (LFC).

The above considerations indicate the interest of brush holders with stable pressure or at least brush pressure systems which guarantee a low variation of brush pressure during the life of the brush.

TABLE of RECOMMENDED SPRING-PRESSURES (in kPa) under NORMAL OPERATING CONDITIONS

Groups of brush grades	On slip rings	On commutators	
		Stationary machines	Traction machines
Hard (or amorphous)		17.5 - 20	25 - 35
Electrographitic	17.5 - 20	17.5 - 20	25 - 45
Resin impregrated electrographitic *		17.5 - 25	30 - 50
Soft graphitic	15 - 20	15 - 17.5	
Metallic { rated speeds	17.5 - 20	15 - 17.5	
Metallic { speed < 1 m/s	25 - 27.5		

* See Technical Note STA AE 16-22.

Remarks:

The surface considered as the basis of calculation for the pressure indicated above does not take into account the empty space under the brush that is (space between the bars of the commutator, grooves of helical rings, oblique saw cuts in the contact faces of the brushes for rings without groove) but only the cross section of the brush.

For bevelled brushes face the pressures are calculated from the cross section and the real surface of the contact face is not used for the base of calculation.

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